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Route Inventories

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Travel and Transportation Management

Planning and Conducting

Route Inventories

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Technical Reference 9113-1

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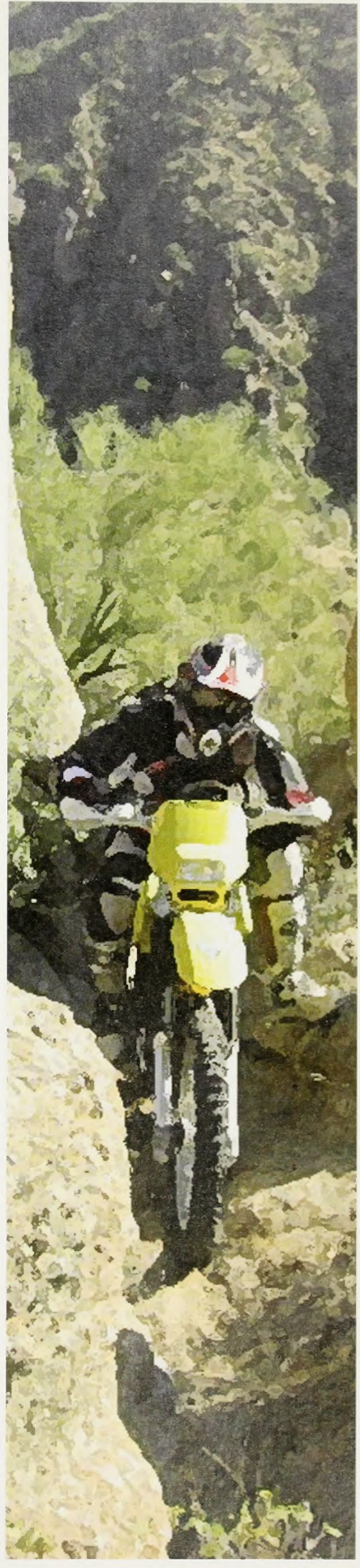

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Abstract

Bureau of Land Management (BLM) Technical Reference 9100-1 describes best practices for planning and conducting transportation-related route inventories. Route inventories identify all existing transportation-related linear features, including potential roads, primitive roads, trails, and travel-associated linear disturbances within a landscape unit. Additional transportation-related linear features, such as airstrips, railroads, and rivers, may also be included as necessary. This inventory methodology is a tool that may be used to help with land use plan development, including the quantification of issues, description of the environment, formulation of land use plan alternatives, conducting of impact analyses, supporting land use planning decisions, and monitoring resource condition changes over time. The BLM has established minimum national data standards for transportation-related linear features (roads, primitive roads, and trails), including Interagency Trail Data Standards (for National Scenic and National Historic Trails) used with transportation-related route inventories. The procedures described herein represent standard and accepted methods of planning for and conducting route inventories by using these minimum national data standards.

Although the primary audience for the present Technical Reference is the Field Office resource specialist responsible for conducting inventories associated with comprehensive travel management, the content is equally useful for engineers, cartographers, geographic information system specialists, volunteers, contractors, and students assigned to the data collection process.

Route Inventory

The purpose of this document is to describe recommended practices for planning and conducting transportation-related route inventories. The route inventory is a snapshot of the existing transportation network within a landscape or planning area as of a specific date.

The transportation network provides both public and administrative access to public lands and contains many features, including roads, primitive roads, and trails—both planned and unplanned (user-created). The route inventory is created by using best available information obtained from satellite and airborne resources combined with on-the-ground field verification and validation.

A transportation route inventory may be used by the Bureau of Land Management (BLM) during the land use planning process to:

- Define current conditions and develop the management situation analysis.
- Quantify land use planning issues.
- Formulate land use plan alternatives.
- Describe an affected environment.
- Conduct an impact analysis.
- Implement and support land use plan decisions.
- Monitor change in resource conditions.

Route inventories are an integral part of Land Use Plans (LUPs)/Resource Management Plans (RMPs), Land Health Assessments (LHAs), Travel and Transportation Management Plans (TTMPs), Facility Maintenance Plans (FMPs), and other associated activity level plans. Route inventories are used as the basis for implementing land use plan goals, objectives, and management actions and can also be used to create a variety of map products for Federal, State, and local governments, as well as the visiting public.

The following recommendations and best practices have been developed by travel and transportation managers, recreation managers, database administrators, geographic information system (GIS) specialists, photogrammetrists, and cartographers. The document does not address how to establish an appropriate route designation, evaluate environmental effects, perform a condition assessment, or decide when to add or remove a route. Rather, the goal of the transportation route inventory is to identify and properly classify all existing routes, whether planned or unplanned (user-created).

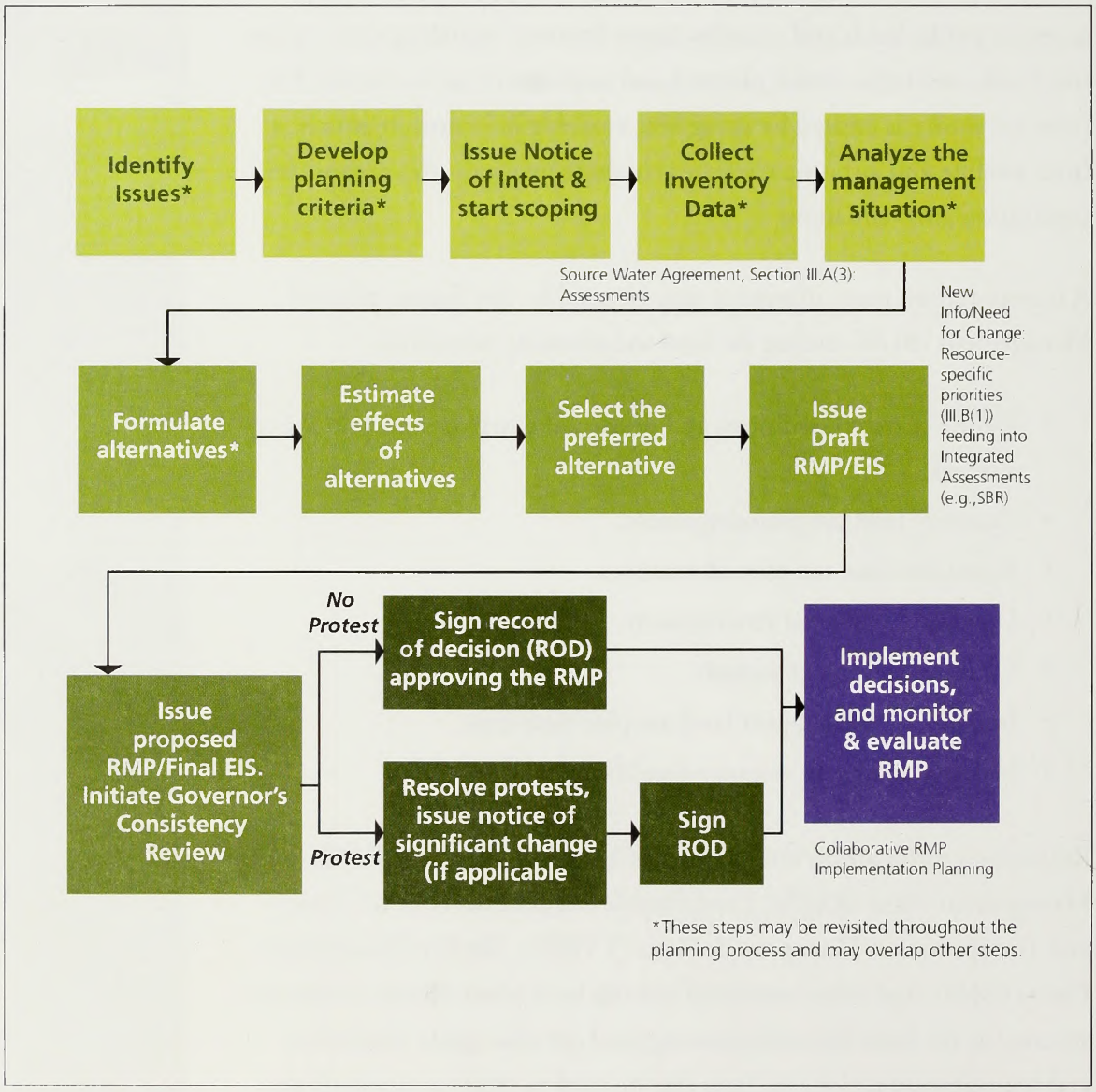

Figure 1. Resource Management Planning Process

The Bureau of Land Management

The BLM is responsible for more than 260 million acres of surface land and manages this valuable public resource for the purpose of sustaining the health, diversity, and productivity of the land for the use and enjoyment of present and future generations. The Federal Land Policy and Management Act of 1976 (FLPMA) directs that "public lands be managed in a manner that protects the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use" by encouraging collaboration and public participation throughout the planning process.

Land Use and Resource Management Plans

The BLM develops Land Use Plans (LUPs) to meet the goals of the FLPMA. Each LUP describes a specific land management area and contains a record of all use and resource decisions. LUP decisions establish the goals and objectives for resource management (desired outcomes) and the measures needed to achieve these goals and objectives (management actions and allowable uses).

The BLM develops a variety of LUPs, but the primary plan that directs decisions for a BLM Field Office is the Resource Management Plan (RMP). The RMP addresses all types of resource uses, including travel and transportation management within the area.

The Resource Management Plan (RMP) describes

- Designation of land uses (limited vs. restricted vs. exclusive, special management, transfers, and others).
- Allowable resource uses and related levels of production.
- Resource condition goals and objectives.
- Program constraints and general management practices.
- Need for areas to be covered by more detailed plans.
- Support actions such as resource protection, realty, access development, and others.
- General implementation sequences.
- Standards for monitoring and evaluating the plan.

The RMP provides the management context to allow for travel management decisions. Travel management decisions are project-level decisions that can be part of the RMP or can be deferred to a separate travel management plan after the Record of Decision (ROD) is signed.

Comprehensive Travel Management

Comprehensive travel management planning addresses all resource use aspects (such as recreational, traditional, casual, agricultural, commercial, and educational)

and accompanying modes and conditions of travel on the public lands. It is not limited to motorized or off-highway vehicle activities.

Travel and transportation routes control access to public lands and are used to protect the resources while providing for recreation and occupancy. Travel and transportation decisions include allowable types of travel (over land, water, and snow, and fly-in) as well as modes and conditions of travel on public lands. The BLM's transportation route inventory process will

- Meet agency business requirements at all levels of the organization.
- Use a systems approach to route inventories that adopts a manageable landscape unit within the overall planning process.
- Ensure that inventories are conducted in coordination, cooperation, and collaboration among program areas and with other agencies, partners, and customers. (For example, although routes located on private lands or portions thereof are considered outside the scope of BLM approval and route designation efforts, these routes may be included in the route inventory because of their emergency access value.)
- Incorporate scientifically credible inventory methodology that meets quality control and quality assurance standards.
- Define the steps to be taken and ensure that those conducting the route inventory are provided with the necessary equipment and supplies to accomplish the tasks.
- Include available information from existing maps, orthoimagery, and local informants.

Data Standards

Route information is a valuable geospatial resource that, if properly managed, can be shared with many users. To maximize the value of the data and to facilitate information exchange, the BLM has established minimum national data standards for route inventories and complies with geospatial accuracy and metadata guidelines.

Minimum National Data Standards

The need for interagency route data standards stems from an increasing need among agencies and partners to take inventory of, assess, and create maps of transportation routes across multiple jurisdictions throughout the United States. In response to the proliferation of nonstandard terminology, the BLM has recently identified minimum national data standards.

As for transportation-related linear features, the BLM now recognizes three route types: road, primitive road, and trail. When describing these route types, the BLM has identified the same set of required attributes for all three types (Appendix A).

The minimum national data standards do not preclude the collection of additional optional information, if necessary. However, when there is a need for a specific optional data element to support a local, mission-related requirement, a formal business case must be submitted to justify expending Bureau resources to maintain the optional information.

Geospatial Accuracy

The BLM complies with the National Standard for Spatial Data Accuracy (NSSDA), endorsed by the Federal Geographic Data Committee (FGDC) in 1998. This standard defines a statistical and testing methodology for establishing the positional accuracy in digital geospatial data with respect to georeferenced ground positions of higher accuracy. NSSDA refers to digital data that are not constrained by scale.

NSSDA established the term radial accuracy, which is defined as the radius of a circle of uncertainty such that the true or theoretical location of points falls within that circle 95% of the time. For example, NSSDA specifies a maximum permissible horizontal accuracy of 19.0 feet at 95% confidence level for geospatial data compiled at 1:6000 scale and a horizontal accuracy of 38 feet at 95% confidence level for geospatial data compiled at 1:12,000 scale.

The NSSDA standard supersedes the National Map Accuracy Standard (NMAS) developed by the Bureau of the Budget in 1947. This original map accuracy standard is still used by the U.S. Geological Survey (USGS) in the production of topographic maps. NMAS is limited by the graphic map scales, whereas NSSDA is digital data that can be represented at any scale.

Enterprise Geographic Information System

Geospatial data are a shared resource between government agencies and the public, and the BLM's enterprise geographic information systems (eGIS) serves as the central repository for these data. The BLM eGIS system:

- Enables Bureau employees and stakeholders to access geospatial data, information, and knowledge, whenever and wherever they are needed, to facilitate interaction with the agency.
- Provides access to automated, maintained, and standardized geospatial data.
- Integrates geospatial information into agency business processes.
- Transforms business information into corporate knowledge that can be evaluated through geospatial applications, state-of-the-art spatial analysis, and visualization tools.
- Supports decision making by allowing knowledge derived from spatial analysis to be used by managers to initiate actions and affect outcomes through a defensible decision-making process.

Within this database, transportation route inventory information represents a valuable shared resource that affects many agencies, as well as future route inventories. The eGIS database set is an essential part of the Bureau's all-digital, production workflow plan. It is extremely important that data collectors work closely with GIS specialists at the State and local levels to ensure that the best possible information is collected and stored.

When preparing a route inventory, the following sources may be useful:

- The **National Integrated Land System (NILS)**, a joint project between the Bureau of Land Management (BLM), U.S. Forest Service (USFS), and State, County, and private organizations, includes interactive maps and reports based on the original Public Land Survey System (PLSS) arranged by section, township, and range. With NILS, a user can display a graphic map developed in the GeoCommunicator application and, with a single mouse click, display associated text-based information from the Land Survey Information System (LSIS).
- The Facility Asset Management System (FAMS), maintained by the Land and Resources Project Office (L&RPO), includes those transportation routes identified as facility assets. While these routes represent less than 10% of the total transportation routes on BLM land, the FAMS database presently contains records of 82,000 miles of roads and 16,000 miles of trails.
- The Recreation Management Information System (RMIS), maintained by BLM Renewable Resources and Planning, includes text-based files describing off-highway vehicle (OHV) area designations (acres designated as open, limited, or closed) for each Field Office.

Metadata

The word metadata is defined as data about data and describes the content, quality, condition, and characteristics of the data. By Executive Order, geospatial data used by the Bureau must be: (1) accompanied by metadata in the format set forth by the Federal Geographic Data Committee (FGDC) and (2) accessible to all interested parties (*http://www.fgdc.gov/*).

Metadata are now part of most GIS software applications and include such descriptive elements as date, time, submitter, section, range, township, longitude, and latitude. The best time to collect metadata is during the data collection process, and the GIS specialist typically completes the metadata information while processing field data. Most current ArcGIS desktop products (ArcView, ArcEditor, and ArcInfo) enable qualified users to create, manage, and edit metadata in the format required by the FGDC.

Conclusion

The Bureau of Land Management is responsible for millions of surface acres of public land and the transportation network provides access to these areas. The transportation route inventory identifies all existing routes and is used in a variety of land and resource management documents.

Demand for an all-digital production workflow has resulted in the conversion of all geographic information into digital format. Route inventory information is collected and added to the BLM enterprise geographic information system (eGIS), then shared with Federal, State, and local agencies, as well as with the general public. Because this is a shared resource, the methods used to collect the data, as well as the terminology used to describe the data, are important considerations in the route inventory process.

Inventory Project Plan

The inventory project plan identifies all resources required for the proposed route inventory and the inventory project map is used to plan and monitor the status of the project.

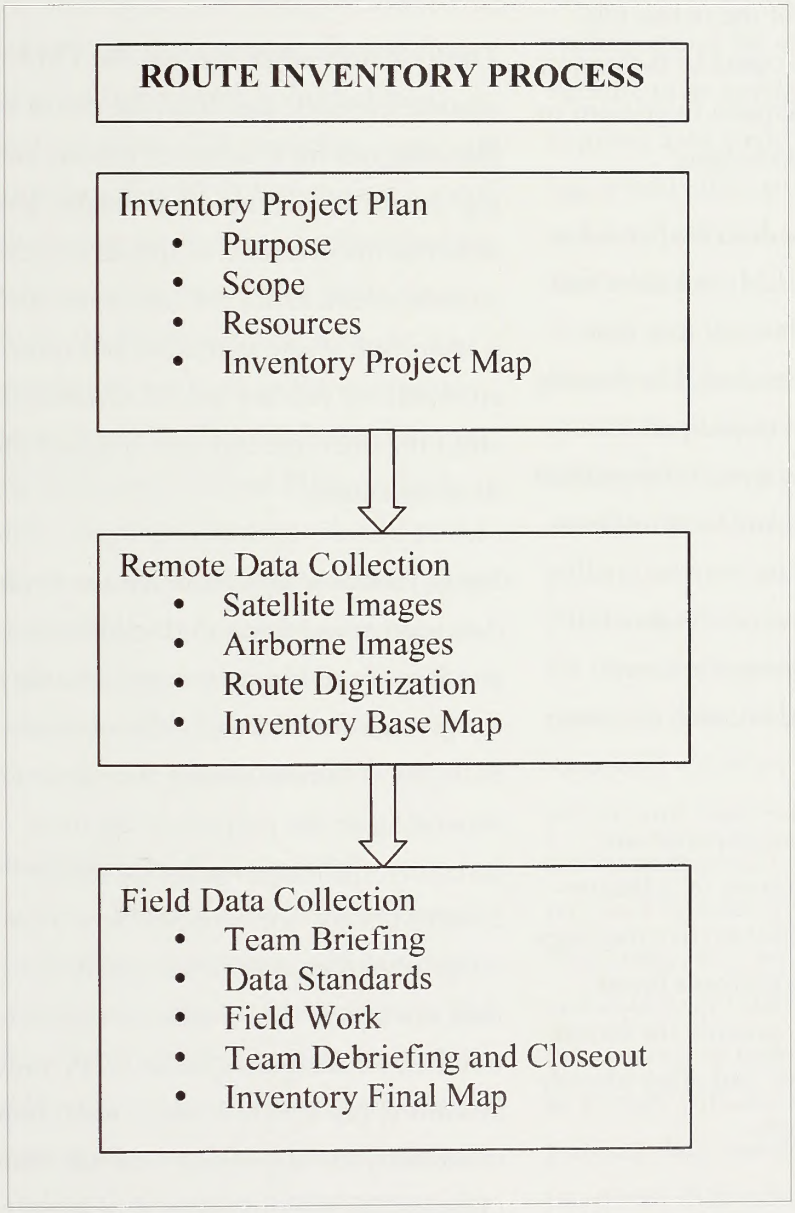

Figure 2. Route Inventory Process

Purpose

The purpose of a transportation route inventory varies. The inventory may be used to formulate or implement a land use plan, to assess effects or describe an affected environment, or to monitor changes over time. In each situation, there are interested stakeholders, both pro and con, who can affect the project outcome. Therefore, the field manager, with the assistance of the public relations officer, should participate in the project announcement and subsequent invitations to affected agencies and stakeholders.

Transportation routes are described as either planned, known to the BLM, and identified on existing maps or unplanned, new user-created routes not yet identified. The existing routes, both planned and unplanned, are identified from previous maps or information from private land owners and local residents, combined with remote data sources (satellite and airborne imagery) and on-the-ground, field data collection. Whereas the actual inventory process is standard, each inventory is different.

Interagency and public participation are central to BLM's commitment to collaboration and cooperation. Collaborative meetings combined with Internet comment forms affect the project success, provide the forum for interested stakeholders, and often identify additional project resources.

Scope

BLM planning areas are typically large (often 1 million acres or more) and complex (variable terrain and environmental conditions). A common method of subdividing these large planning areas into manageable landscape units is to define Travel Management Areas (TMAs). The TMA portion of a larger planning area identifies unique travel management (either motorized or nonmotorized) circumstances that require particular focus and analysis.

The local field office may use the TMA to separate a specific area from the rest of the planning area for a variety of reasons including complexity, the need for a higher level of public involvement, or special resource considerations. Once the area under study is identified, image resolution and route attributes are two key project variables that affect the total cost and time required for the route inventory.

Image resolution applies to remote sensing data sources and refers to the ability to see and identify an object or a linear feature on the ground. Satellite and airborne data are examples of remote sensing sources and, depending on the purpose of the route inventory, the image resolution requirements will vary. For example, 3- to 5-meter image resolution may be acceptable for a road inventory; 1- to 3-meter image resolution may be acceptable for an OHV route inventory; but 0.5- to 1-meter resolution is necessary for identifying a narrow hiking or equestrian trail inventory. The greater the required resolution, the higher the total price for the remote data.

Route attributes (also referred to as data elements) refer to the descriptive information that must be collected during the inventory. Although suspected routes can be identified from airborne images, all routes must be verified and the associated route attributes must be validated by members of the on-the-ground field crew.

Proper identification of route attributes is an important task that requires effective communication between BLM field officers, resource planners, GIS specialists, users, and stakeholders. The BLM has adopted a set of required route attributes to be identified for all transportation routes (Appendix A). In addition, the BLM complies with the recommendations set forth in the Interagency National Trail Data Standards for National Scenic Trails and National Historic Trails. If possible, the project manager should perform a field reconnaissance of the proposed project area to clarify boundaries, become familiar with the existing transportation network, and develop a clearer understanding of the terrain and route conditions.

Resources

Resources required for the inventory project are funding, equipment, and personnel. One important outcome of interagency and public collaboration is the identification of suitable resources for the project. In addition to locating geospatial data, motor vehicles, and technical equipment, collaboration can also identify personnel with a vested interest in the success of the project.

The BLM recommends that each of the following staffing sources be considered:

- BLM employees
- BLM volunteers
- Specialty contractors
- Students

BLM field office employees familiar with the local area can be the most cost-effective staffing source for a route inventory project. Because these employees have completed the required field safety and equipment training, a field office ground crew can be ready to participate in the data collection process after a brief, 1-day orientation. The National Science and Technology Center (NSTC) Branch of Resource Technology employs GIS specialists, photogrammetrists, and cartographers who are also available to advise and assist in the route inventory project.

BLM volunteers are an excellent resource for inventorying, monitoring, and patrolling routes for resource protection. The most successful volunteer programs exhibit a serious and continuous commitment by field managers and employees; some offices pair each volunteer with a BLM employee. Volunteers must meet the same safety and equipment training as employees and contractors, so more time may be required to prepare volunteers for route inventory projects. Additionally, if volunteers plan to operate their personal motor vehicles, motorcycles, or all-terrain vehicles during field data collection, they must present the

same evidence of operator training that is required of employees. The cost of using volunteers is usually limited to fuel and meal reimbursement and may, under certain circumstances, include a per diem allowance.

Specialty contract crews and GIS specialists are being used at some field offices to create and update route inventory maps, as well as to conduct the actual field data collection. A contract crew that is familiar with route inventory procedures, the use of geospatial technical equipment, and field data collection processes can be the best available resource, especially when field office personnel are unavailable. The contracting process is complex and takes time. The NSTC staff is available to assist field offices with the statement of work, evaluation of bids, technical oversight, and inspection of deliverables.

Students enrolled at educational institutions with a local BLM agreement or participants in the Environmental Studies Unit network are also excellent resources. The BLM encourages consideration of Historically Black Colleges and Universities (HBCUs) and the Hispanic Association of Colleges and Universities (HACU). Where attribute verification is more intensive, students from local universities and colleges or local environmental groups may be particularly valuable. Again, the NSTC staff is available to assist field offices interested in using students from area educational institutions.

RESOURCE	ADVANTAGES	DISADVANTAGES
BLM field office employee	Low cost. mileage/per diem Familiar with local area BLM training current IT First Aid/CPR Field Operations Safety Motor Vehicle 4x4 Safety ATV/OHM	Unavailable (sched conflicts) May need GPS/GIS training
BLM field office volunteer	Low cost: mileage, meals or per diem Familiar with local area Some BLM training current	May need Volunteer Agreement May need GPS/GIS training May need some BLM training
Specialty Contractor	GPS/GIS trained Trained: First Aid/CPR trained Motor Vehicle 4x4 Safety Special Equipment Field Operations	Unfamiliar with local area Contract required Expensive
Students	May be familiar with area Good public relations Important recruitment tool	May be unfamiliar with area Needs First Aid/CPR Needs Field Operations Needs GPS/GIS May need IT training May need Motor Vehicle May need 4x4 Safety May need ATV/OHM

Figure 3. Staffing Resources

Inventory Project Map

The inventory project map is the focal point of meetings and planning sessions. At a minimum, the project map should identify the geographic project boundaries, land ownership within the project area, existing transportation routes, BLM structures and recreation sites, other agency structures and sites (such as historic or scenic trails), and any other resource data identified by the project manager.

The inventory project map can be informal (hand drawn) or formal (containing digital geospatial data), depending on the available resources. When the previous route inventory map is available, then this map becomes the current inventory project map. However, when there is no previous map, or when significant changes have taken place since the last inventory, it may be necessary to draft a new inventory project map.

Search for all map sources that are available through the BLM, other agencies, State and local governments, businesses, local residents, and interested stakeholders. It is important that the project map shows the entire area under consideration. As the project nears completion, a simple grid overlay converts this map into the project status map.

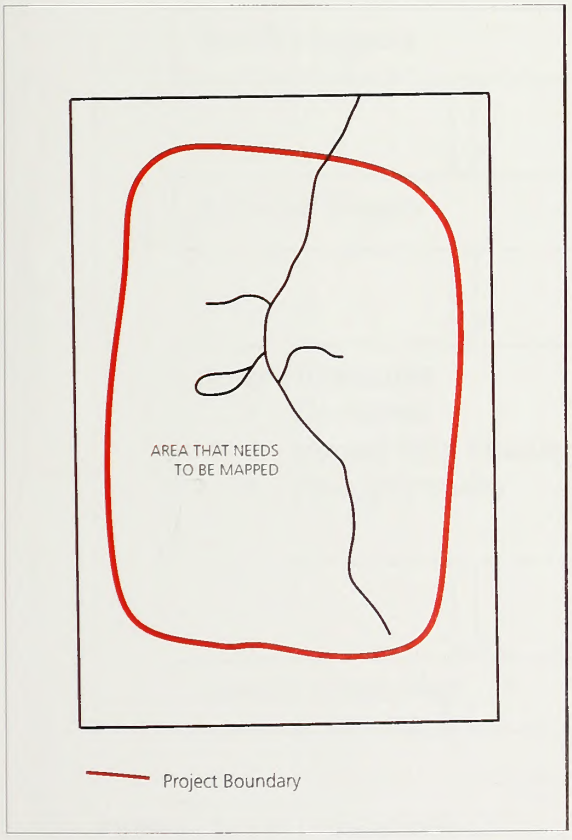

Figure 4. Inventory Project Map

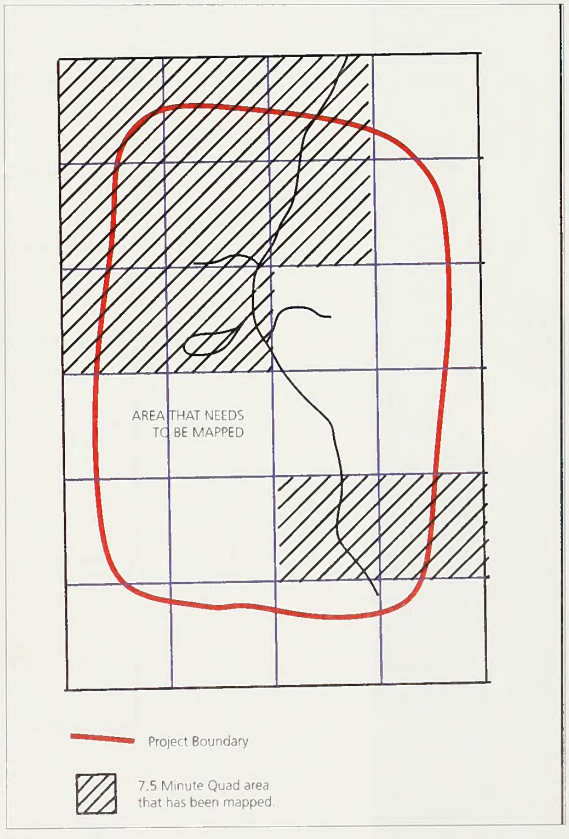

Figure 5. Project Status Map

Conclusion

The purpose of the route inventory project plan is to balance the project requirements against the available resources. The physical size of the route inventory area, the cost of securing acceptable remote data, the number and complexity of route attributes to be identified, and the nature of the terrain to be studied are key factors that affect the resource requirements.

The actual route inventory can be performed by field office employees, volunteers, contractors, students, or any combination of these. All participants must be properly trained to work in an outdoor environment typical of BLM public lands.

The inventory project map illustrates the entire geographic area to be studied, identifies any special areas of ownership or jurisdiction, and is used for the initial announcement, the collaborative planning meetings, and as a status map of the project over time.

Remote Data Collection

As soon as the inventory project plan and inventory project map are complete, the route inventory process may begin. The recommended best practice is to identify available remote data sources before launching on-the-ground, field data collection. Remote data sources and satellite and airborne images are available through government and commercial sources and, with proper interpretation, this digital geospatial information can be used to identify existing transportation routes.

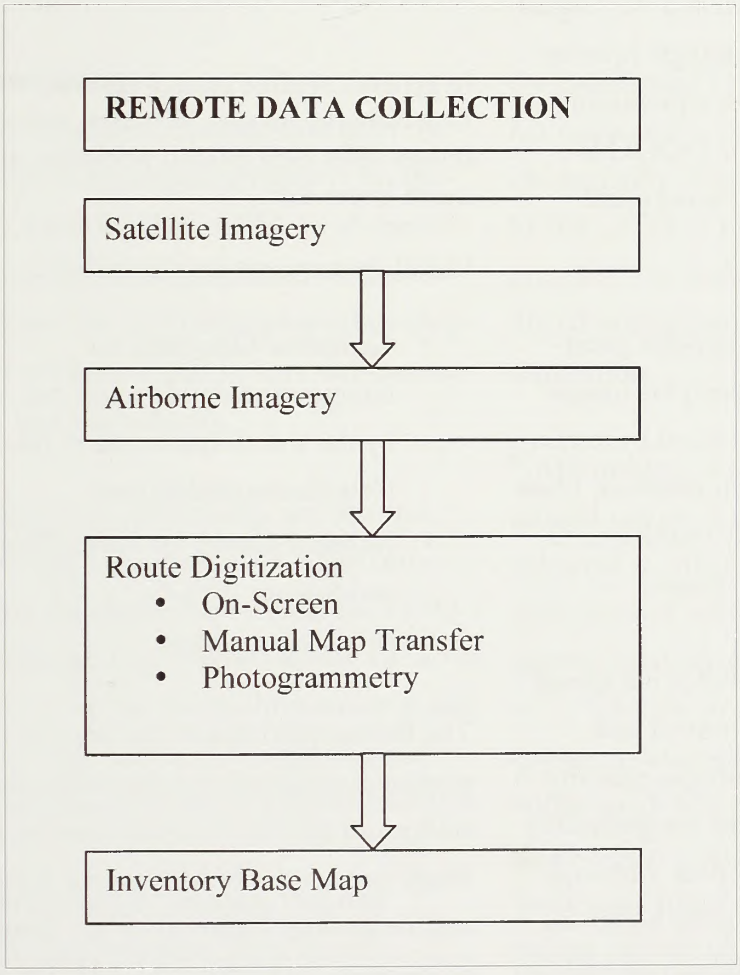

Figure 6. Remote Data Collection

The inventory project map describes the entire project area under consideration and, with a grid overlay, is used as the project status map. A common grid overlay approximates the area in a traditional USGS 7.5-minute quadrangle. Each grid unit represents an inventory base map used in the field for data verification and validation.

The 7.5-minute quadrangle is a common unit of measure for geospatial information. The Digital Orthophoto Quadrangle (DOQ) is an area that approximates a standard USGS quadrangle, and the Digital Orthophoto Quarter Quadrangle (quarter quad or DOQQ), is an area representing one quarter of a DOQ. The DOQQ is the preferred resolution for most route inventories.

DOQs and DOQQs are computer-generated, ortho-corrected photographic images where image displacement caused by terrain relief and sensor tilt has been removed. These digital graphic files are easily transferred to any GIS that accepts raster images.

The use of DOQs and DOQQs has spread rapidly to all levels of government and commercial use and these images typically serve as the cartographic base for generating and modifying planimetric data. Although seamless map images are rapidly becoming available, most imagery products are still distributed in the familiar DOQ and DOQQ units of measure.

Satellite Images

Digital images obtained by satellite are available through the BLM, other government agencies, and private firms. Although once considered costly, satellite images can be cost-effective for very large project areas or when a date-specific image is required.

For an impact analysis project, a satellite can be tasked to obtain an image of a certain area on a specific date and time. For a monitoring project, the most recent satellite image may be the best available source of information for an area undergoing rapid change.

In general, satellite images are more recent than airborne images. However, airborne images offer high ground resolution at a much lower cost.

Useful government sources include:

- Geospatial One-Stop, an intergovernmental project managed by the U.S. Department of Interior (*http://www.geodata.gov*).
- National Center for Earth Observation and Science (EROS; (*http://edc.usgs.gov/*).

The Bureau participates in a number of geospatial programs that may affect the availability and the cost of certain satellite images. Please contact the BLM National Science and Technology Center (NSTC), Branch of Resource Technology, ST-134, for assistance in the identification of suitable satellite image sources (*http://www.blm.gov/nstc/*).

SATELLITE	DISTRIBUTOR	SPATIAL RESOLUTION PANCHROMATIC-MULTISPECTRAL (METERS)	REVISIT CYCLE (DAYS)	SWATH WIDTH (KILOMETERS)	APPROX. COST PER SQUARE MILE* (DOLLARS)
QUICKBIRD	DIGITALGLOBE	0.61-2.44	Variable	16.5	100.
IKONOS	SPACEIMAGING	1-4	Variable	11	47.
EROS	McELHANNEY	1.8 (Panchromatic)	Variable	3.5	25.
SPOT 5	SPOT IMAGE	2.5 & 5-10	26	60 & 120	6.50
IRS 1C	LANDINFO	5.8-23	24	70 to 810	1.50
SPOT 1-4	SPOT IMAGE	10-20	26	20	2.50
LANDSAT 7	EROS DATA				
CENTER	15-30	16	185	0.20	

* Represents highest available resolution, ortho-corrected data. Cost estimates, Nov. 2005.

Figure 7. Relative Cost of Satellite Imagery

Airborne Images

Standard film frame cameras have been the workhorse of the mapping industry for generations. Growing demand for an all-digital production workflow combined with orthoimagery and the rapid technological development of airborne digital sensors and cameras has changed the industry.

New acquisition, processing, and distribution methods have made DOQs instantly accessible. Purchasers now expect the DOQ to register with data overlays having a relative precision to within one to three screen pixels. Basic accuracy statements or specifications are usually found in the DOQ metadata files.

National Agriculture Imagery Program

The U.S. Department of Agriculture's (USDA) National Agriculture Imagery Program (NAIP) acquires digital images during the agricultural growing season in the continental United States. This program has replaced the earlier National Aerial Photography Program (NAPP) sponsored by the USGS. A primary goal of the NAIP program is to enable the availability of digital orthophotography within a year of acquisition.

NAIP imagery is available at a 1-meter ground sample distance (GSD) and is delivered as either quarter quad tiles or a compressed county mosaic (CCM). A quarter quad tile covers approximately a 5.5 × 5.5-mile area, or 3.75 × 3.75-minute quarter quadrangle, plus a 300-meter buffer on all four sides. A county mosaic is generated by compressing digital quarter quadrangle image tiles. All individual tile images and the resulting mosaic are rectified to the UTM coordinate system, NAD 83, and cast into a single, predetermined UTM zone.

National Aerial Photography Program

The USGS National Aerial Photography Program (NAPP) provides a standardized set of cloud-free aerial photographs covering the conterminous U.S. that were taken over 5- to 7-year cycles. The NAPP archive (1987–2003) is still a popular base layer for many GIS products.

NAPP photographs were acquired from an altitude of 20,000 feet and are available in black and white (B&W) or color infrared (CIR), depending on location and date. Each photo is centered on a one-quarter section of a 7.5-minute USGS quadrangle, and covers approximately a 5.5 × 5.5 mile area, or 3.75 × 3.75-minute area.

All NAPP films are now available as digital orthophotos (DOQs or DOQQs). The original NAPP aerial film has been delivered to the USDA Aerial Photography Field Office in Salt Lake City, Utah, which is home to a national film vault that archives more than 10 million aerial images dating from 1955 to the present.

Route Digitization

Route digitization is the process of identifying transportation routes on a remote image using photogrammetry, on-screen digitization, a digitizing tablet, or manual map transfer.

Photogrammetry is the most accurate and complete method of route identification and digitization. This process uses airborne images to create three-dimensional representations of the Earth's surface. Because airborne images are available in 1:24,000 or 1:40,000 scale and are more recent than DOQs or DOQQs, this option is most appropriate for small or critical areas requiring high accuracy. The NSTC staff can provide photogrammetry services for small areas (less than 50 square miles) and will assist in locating qualified contractors for larger inventory areas.

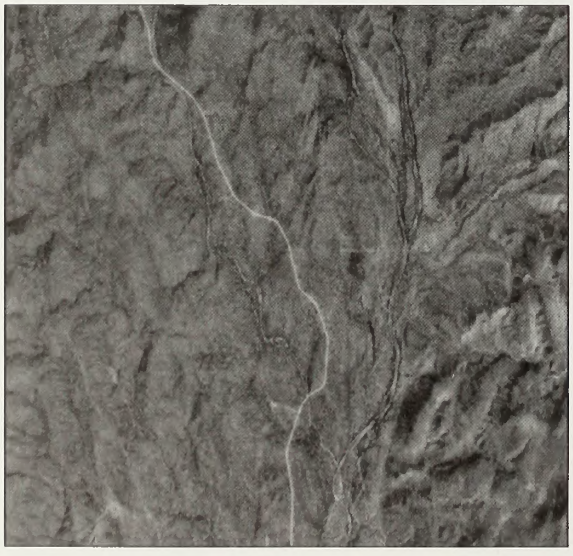

Figure 8. Digital orthophoto quarter quadrangle (DOQQ).

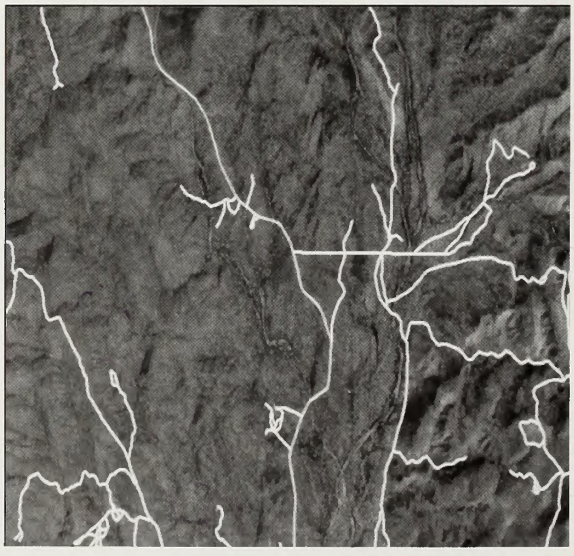

Figure 9. Digital orthophoto quarter quadrangle (DOQQ) with digitized routes.

On-screen digitization is the process of drawing the routes onto a DOQQ, or similar digital image, by using a computer screen and pointing device. Although less accurate than photogrammetry with stereo viewing capabilities, this approach requires less time and fewer resources than photogrammetry.

A digitizing tablet enables a trained interpreter to draw routes onto a map layer using any map source (photograph or printed map). Although less accurate than photogrammetry, when a digitizing tablet is available this approach can be as effective as on-screen digitization.

Manual map transfer requires a scanner and a transparent, map-registered overlay. Using line maps or airborne images, the interpreter traces routes directly onto the overlay, then scans the result to create a digital data set.

Conclusion

Working from the overall project map with a grid overlay, each smaller area represents an inventory base map. A best practice is to identify existing routes within the inventory base map by using remote source data before launching on-the-ground, field data collection.

The inventory base map is developed by trained interpreters using a variety of route digitization techniques. The purpose of the inventory base map is to identify all transportation routes within an area.

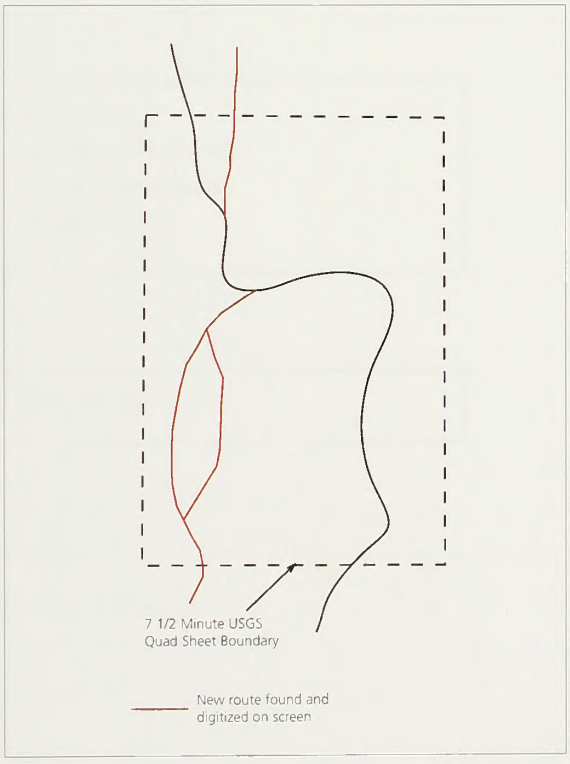

Figure 10. Inventory Base Map with Digitized Routes

Field Data Collection

As soon as the inventory base map is complete, field data collection may begin. The purpose of the field data collection is to verify the existing transportation routes and to identify any new, unplanned routes.

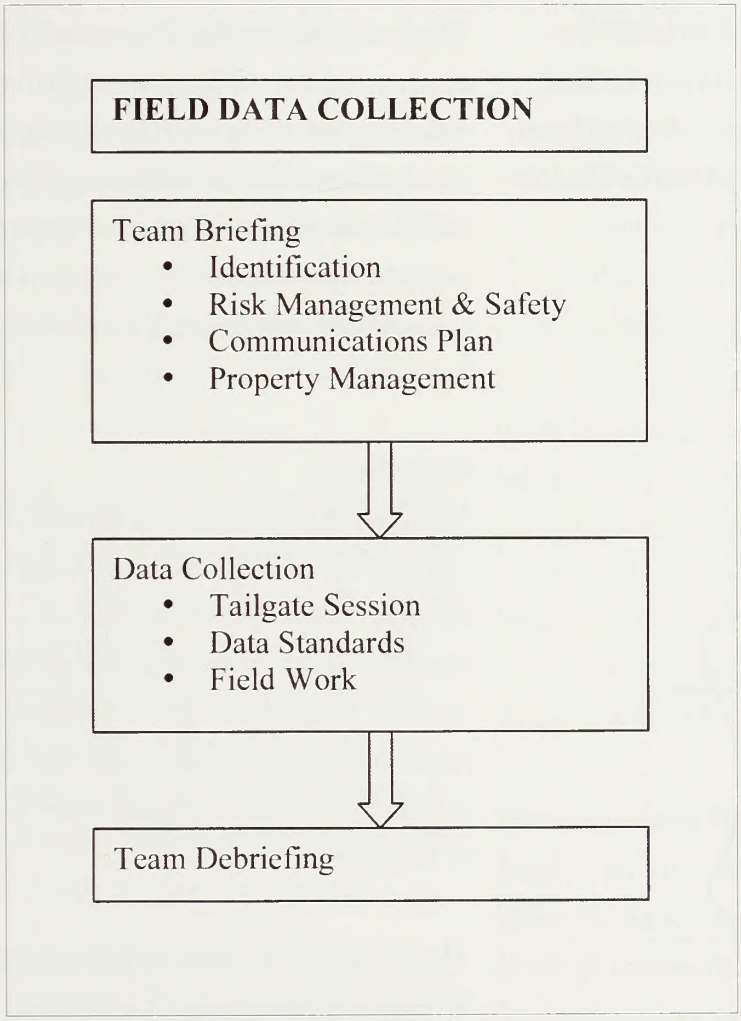

Figure 11. Remote Data Collection

It is important that the field work proceeds in an orderly, systematic way. As with the inventory project map, a grid overlay is applied to the inventory base map to facilitate team assignments and to ensure the highest probability of locating unplanned (new) transportation routes.

The inventory base map should identify all private land within the inventory area and include contact information to land owners. Where isolated patches of private land parcels are located, field crews should request permission to access the land before conducting field data collection.

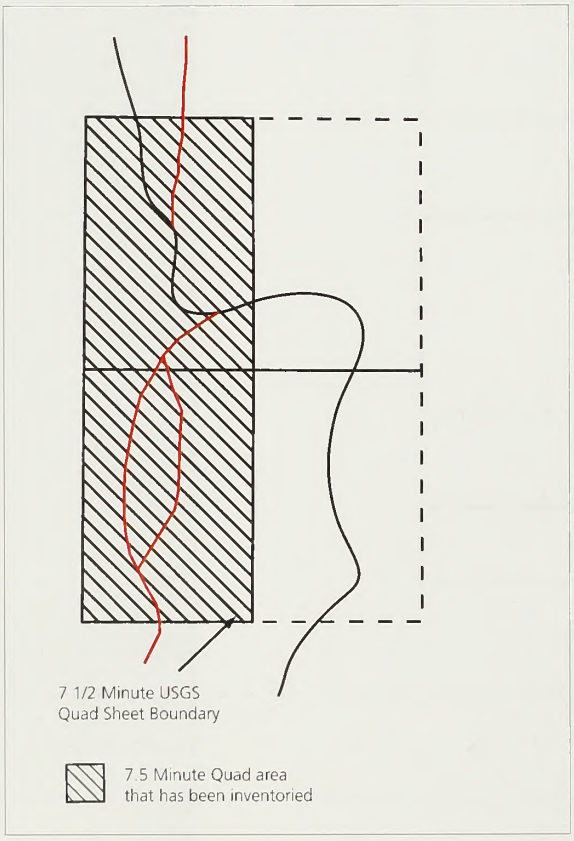

Figure 12. Inventory Base Map with Status Grid

Team Briefing

Depending on the size of the project area, the number of people involved in the field work, and the level of experience of the members of the crew, the field work briefing may require 1 or more days. Host the field work briefing at the local field office and invite all project coordinators, GIS specialists, and field crew members to attend.

The field work briefing is an excellent opportunity for verifying and updating safety training, presenting training regarding data standards and Global Positioning System (GPS) collection methods, and improving field team communications. A properly trained team will generate better field data in less time.

Identification

Members of each field crew should be easily identifiable. In addition to government identification cards, special project hats or shirts may be helpful. When multiple groups are involved (employees, contractors, and volunteers), it is especially important that all team members can easily recognize other members of the team.

The ground crew includes field supervisors, GPS technicians, and GIS specialists. The supervisor assigns the daily tasks, troubleshoots problems in the field, and is responsible for the safety and well-being of the ground crew.

The support crew includes field office dispatchers, BLM and local law enforcement officers, and emergency response teams. Every member of the support crew should be notified of planned ground crew activities and every member of the ground crew should be able to contact appropriate members of the support crew.

Risk Management and Safety

The BLM uses the Risk Assessment process to minimize personal injuries and property damage or loss. Because working in an outdoor field environment and traveling to and from remote locations can be hazardous, the inventory project manager and supervisors prepare a Risk Management Worksheet (BLM Form 1112-5) before the project begins.

The Risk Management Worksheet identifies the potential risk of known task hazards and describes best practices to follow to minimize this risk. Best practices include a combination of training, personal protective equipment (PPE), supervisory controls and, in some situations, avoidance. (For example, if the local forecast predicts severe weather, the daily field activities may be postponed.)

Supervisors are responsible for verifying that all crew members (employees, contractors, and volunteers) are properly trained and qualified before they are authorized to perform hazardous tasks. Employees are required to provide evidence of safety training, wear BLM-supplied PPE, and follow safe working practices.

Recommended training for members of a route inventory field team includes:

- First Aid, Cardiopulmonary Resuscitation, and Bloodborne Pathogens.
- Defensive Driving, including Four-Wheel Drive Safety.
- Trailer Safety: proper loading, balancing, and unloading techniques.
- Off-Highway Vehicle Safety: basic operations for ATVs, motorbikes, and other vehicles.
- Field Injury Prevention.

All field-going crews are required to wear proper field attire and be prepared to wait 24 hours if lost. The BLM strongly recommends using the buddy system during all field operations. For additional information, consult BLM Manual Handbook H-1112-2, Safety and Health for Field Operations.

Communications Plan

Field crews will follow the local BLM field office check-out and check-in procedures and verify all communications equipment before leaving the office or ware yard. It is extremely important that every member of the field crew knows the planned return time and the specific time when search and rescue efforts will be started.

Where there are known radio telecommunications "dead" zones, file a ride plan with the local dispatcher. This diagram of the planned travel route should identify known dead zones and illustrate the direction of travel. The ride plan clearly identifies communication points to use before entering and after leaving a communications dead zone.

Property Management

BLM property regulations require all employees, contractors, and volunteers to acknowledge receipt of government property such as motor vehicles, ATVs, and motorbikes, telecommunications equipment, GPS receivers, and GIS data collection units. Each person is responsible for all government property issued and must account for the property at the end of each project.

Data Collection

The field data collection is accomplished by using GPS receivers and associated data collection field units, supplemented with written field notes and digital photos.

Tailgate Session

Each day, before leaving for the field, the supervisor hosts a brief tailgate session with members of the ground crew. Typical topics include: check-out and check-in procedures, vehicle readiness checks, communications checks, field attire checks, safety topics, weather forecasts, late-breaking local news, and search grid assignments.

The choice of proper ground transportation to use while gathering field data is unique to each project and depends on the area designation (Wilderness, Open, Limited, and so forth), the terrain, and the available resources.

Basically, the field crew can either walk or ride the route to be inventoried and there are GPS receivers and collection units to accommodate either situation. In areas open to off-highway vehicles, the field crew may choose to ride motorbikes or ATVs and mount GPS receivers on the vehicles. In Wilderness Areas, or in areas characterized by rough and rugged terrain, the field crew may choose to hike the route, use pack animals, or ride horses and carry GPS gear in a backpack or saddlebag.

Data Standards

To ensure the best quality data, every member of the field crew must understand how to correctly apply the route attributes included in the project's data dictionary. The data dictionary is part of the GPS software configuration task and the BLM recommends that a summary of the attributes and their definitions be distributed to all members of the field data collection team (Appendix B).

The BLM has published minimum national road and trail data standards in the Roads and Trails Terminology Team Report (2006) and complies with the recommendations of

the Interagency Trail Data Standards (2004) published by the National Park Service. While required attributes are common to all route inventories, many attributes are chosen to meet the specific needs of a particular inventory project. A clear understanding of each attribute in the project data dictionary, along with a clear definition of attributes, is essential to maintaining a quality route inventory.

Field Work

The purpose of field work is to verify and classify transportation routes identified on the base inventory map, as well as to identify and classify user-created, unplanned (new) routes discovered in the field. In addition to written field notes, photos may be taken at strategic locations in the project area to aid in current or planned monitoring studies.

GPS receivers and data collection units have limited storage capacity and it is often necessary for field crews to meet with GIS specialists to download the data files. The raw data downloaded from the GIS collection units must be differentially corrected and brought to standard projection and datum reference by the GIS specialist before being used to update the inventory base map. During this process, the GIS specialist may notice extraneous vectors and spurs that need to be verified by the ground crew.

The ground crew is uniquely qualified to resolve any ambiguous information obtained from remote data sources. For example, only the ground crew can verify the location of a trail that is partly obscured by tree cover. Or, only the ground crew can properly distinguish a linear feature as either a pipeline or a fence line.

Good field notes, digital photos, and timely communication between field crews and GIS specialists are essential for conducting a quality route inventory.

Team Debriefing

When all ground crews have completed their assigned grids, the field work is complete. When the GIS team completes postprocessing (differential correction and editing), the data collection is complete. However, the route inventory field work is not complete until:

- Each crew member accounts for and returns all government property. If the property is damaged, a Report of Survey may be required (contact the Field Office Property Manager for direction and assistance).
- Each supervisor has reported and verified any personal injuries sustained by employees, contractors, or volunteers (contact the Field Office Safety Officer for direction and assistance).
- The GIS specialist has identified all metadata and transferred the final inventory data to the appropriate geospatial databases.

- The project manager has identified the resources required for the total project and summarized the lessons learned.

Conclusion

The purpose of field data collection is to verify and validate route inventory information identified from remote data sources and to locate new, user-created routes within a specific area. Only the field crew can determine whether a linear feature is a road or a pipeline or classify the route attribute as a hiking or equestrian trail.

A properly trained field data collection team is an essential component of a successful route inventory project. All participants must understand the hazards of the outside working environment and know how to properly classify route attributes in accordance with national and interagency route data standards.

With the completion of the field data collection, the route inventory project comes to a close. The project manager is responsible for the transfer of all geospatial information and field notes, return of all government property, project summary reports, and delivery of the inventory final maps or maps. The inventory final maps will serve as the inventory base maps when a future route inventory project is conducted.

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Appendix A.
Minimum National Data Standards

To ensure data consistency and information sharing, the BLM has adopted three transportation route types: Road, Primitive Road, and Trail. The following data elements (route attributes) are required for Road, Primitive Road, and Trail route types and their associated segments.

Asset[1]	**Data Element (required)**
Road, Primitive Road, or Trail	Latitude
	Longitude
	Meridian
	Township
	Range
	Section
	Aliquot Part
	Functional Class
	Congressional District
	Locator Code
	Easements Needed
	Admin State
	Geographic State
	OR/CA Land
	Route Number
	Spur Number
	Begin Route
	Terminus
	Year Withdrawn
Segment	Begin Mile
Road, Primitive Road, or Trail	End Mile
	County
	Jurisdiction
	Maintenance Responsibility
	Maintenance Level
	Condition (On Main Screen)
	Surface Type
	Average Width

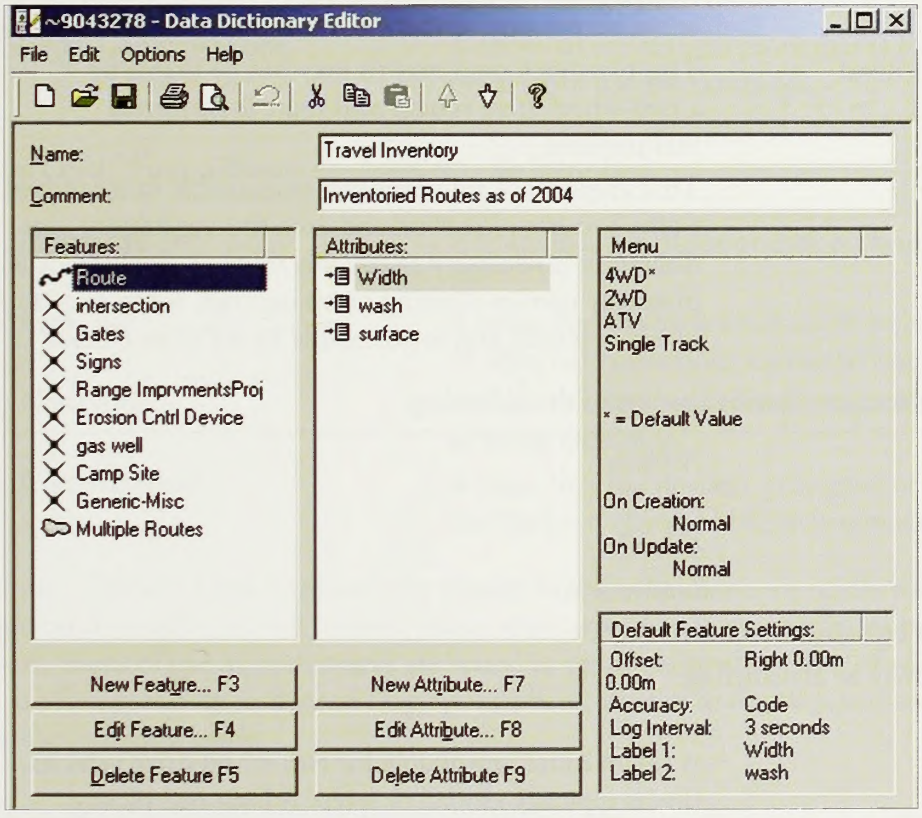
Asset Category Code (On Main Screen)
OR/CA Land
Road Surface/Trail Surface
Congressional District
Meridian
Township
Range
Section
Aliquot Part

---

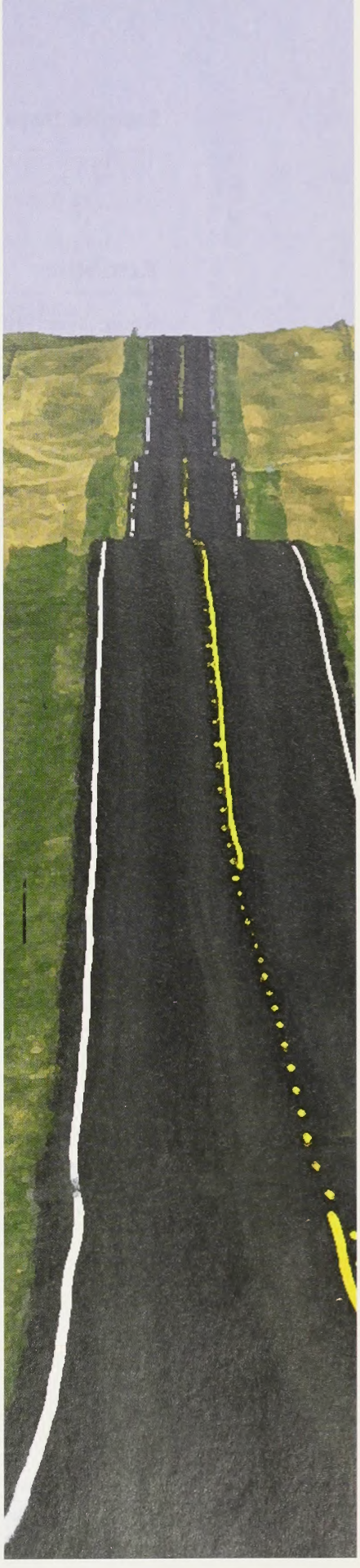
[1]Asset—The Facility Asset Management System (FAMS) includes only those transportation routes defined as assets in the BLM transportation system. For continuity, all routes follow the FAMS guideline (source: *Roads and Trails Terminology Team Report, 2006*, Appendix 7. Proposed Minimum National Data Standards).

Appendix B.
Data Dictionary

Route attributes, also known as data elements, are included in the GPS data dictionary. The data dictionary includes all attributes, required and optional, that must be identified during the field data collection process. The number of attributes in the data dictionary has a direct effect on time and total cost to complete the route inventory and should be kept simple so that field data collection crews can quickly gather data without ambiguity.



Appendix Figure. Sample Data Collector Screen



Sample Data Dictionary Attributes and Definitions

To improve the quality of data collected during the field inventory, brief descriptions of the route attributes should be distributed to field crew teams. For example:

Attribute	Description
Route Type: Routes may be classified as one the following types:	
1. Primary Paved Road	This road provides access between major points and includes major and minor highways.
2. Primary Unpaved Road	This road is regularly maintained, wide enough for at least two vehicles, provides access between major points, and serves a large area branching from it.
3. Secondary Paved Road	This is a paved road, not a highway, with other roads of lesser quality branching from it. It is not usually striped and connects primary roads and major points.
4. Secondary Unpaved Road	This one-lane road is regularly maintained with other roads of lesser quality branching from it. It usually connects primary roads and major points.
5. Tertiary Unpaved Road	This two-track road may or may not be usable by a two-wheel drive vehicle and there is no formal maintenance.
6. Single Track	This single-track route is often inaccessible to motorized traffic because of erosion and excessive vegetation; user discretion is necessary to use this route. A single track is primarily used as a hiking or biking trail, is less than 1 meter in width, and is not usable by ATVs or trucks.
Surface: Route surfaces are classified as one of the following:	
1. Primary	Asphalt.
Concrete.	
2. Secondary	Gravel.
3. Tertiary	Native soil.
Bedrock exposed by erosion.	
Use: Use activities may be classified as:	
1. 4WD	A rough route, unsuitable for two-wheel drive vehicles, that is typically eroded or steep. A long-bed pickup truck might have trouble here, especially when crossing a narrow wash.
2. 2WD	A smooth route that presents little or no difficulty for high-clearance, two-wheel drive vehicles. This category includes all paved roads, most secondary unpaved roads, and a few tertiary unpaved roads.

Attribute	Description
3. Motorcycle	A route that is identifiable by the presence of tire tread marks and occasional accessories.
4. ATV	A route that is identifiable by the presence of unique, wide aggressive tire tread marks.
5. Bicycle	A route that is identifiable by the presence of narrow tire tread marks.
6. Hiking	A single-track trail, usually located in a Wilderness Area, that is identifiable by the presence of footprints. While some motorized trails may be used by hikers, a hiking trail is usually rougher than a motorized trail and is, therefore, not used by ATVs, motorbikes, or bicycles.
7. Equestrian	A route used for horseback riding that is identifiable by the presence of dung and hoof marks.
8. Snowmobile	A snow- or ice-covered route that is identifiable by the presence of unique, wide-tracked tread marks and narrow ski tracks.
9. Cross Country Skiing	A snow- or ice-covered route that is identifiable by the presence of narrow ski tracks.

Use Level: Four different use levels may be identified:

1. Heavy use	A route that has direct or indirect evidence of regular use.
2. Light use	A route that has clear evidence of infrequent use in light of observed environmental factors (e.g., precipitation).
3. Nonexistent	A route that has been recently abandoned or is in a state of being reclaimed.
4. Undetermined	A route that has no clear indicators of use or the level of use has been obscured by environmental factors.

Note: The Use Level attribute may require further comment, especially where indicators are unclear. It may be helpful to study other route aspects such as whether or not the route is a wash. Signs of use in wash routes are erased or relocated by the action of wind and water and it is often necessary to depend on physical characteristics to decide whether to include these in the route inventory.

Examples of optional data attributes include:

Gate
Sign
Gas Well
Campsite
Multiple Route Area
Guard Rail
Cattle Guard
Culvert

Appendix C.
Glossary

7.5-minute Quadrangle: A USGS paper map product at 1:24,000 scale covering 7.5 minutes of latitude and 7.5 minutes of longitude. Features shown include elevation contours, roads, railroads, water bodies, buildings, urban developments, and wetlands. This is a basic layer of information for many ecological and natural resource applications. An automated version of the 7.5-minute quadrangle is called the digital raster graphic or DRG. It is informally known as 7.5-minute quad.

Accuracy: Degree of conformity with a standard or accepted value. Accuracy relates to the quality of a result and is distinguished from precision which relates to the quality of the operation by which the result is obtained.

Assessment: The act of evaluating and interpreting data and information for a defined purpose.

Assets: Engineering term used to describe roads, primitive roads, and trails that are included in the Facility Asset Management System (FAMS). Assets are maintained through the deferred maintenance program.

Base map: An initial map on which information may be placed for purposes of comparison or geographical correlation. Photo interpreted data are transferred to a base map to rectify and register the data. Route inventory base maps usually consist of USGS DOQs or specially made orthophotos.

Bench mark: Relatively permanent material object, natural or artificial, bearing a marked point whose elevation above or below an adopted datum is known.

Cadastral: A Latin term from "cadastre" referring to a registry of lands. Cadastral surveying is the process of determining and defining land ownership and boundaries.

Cadastral map: A map showing boundaries or subdivisions of land for the purpose of describing and recording ownership. It may also show culture, drainage, and other features relating to land use and value (see also plat).

Cadastral survey: A survey that creates, marks, defines, retraces, or reestablishes the boundaries and subdivisions of the public land of the United States.

Cartography: The science and art of making maps and charts.

Closed area: An area designation indicating that the area is not available for a particular use or uses. Refers to specific definitions found in law, regulations, or policy guidance for application to individual programs. For example, 43 CFR 8364 defines "closed" as it relates to closure and restriction orders and 43 CFR 8340.0-5 defines "closed" as it relates to off-road vehicles.

Closed road or closed trail: A route that is restricted from certain types of use during certain seasons of the year. The prohibited use and closure period must be specified.

Code of Federal Regulations (CFR): The codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal government (*http://www.gpoaccess.gov/cfr/index.html*).

Collaboration: A cooperative process in which interested parties, often with widely varied interests, work together to seek solutions with broad support for managing public and other lands.

Collaborative partnerships: Refers to people working together, sharing knowledge and resources, to achieve desired outcomes for public lands and communities within statutory and regulatory frameworks.

Contour: An imaginary line on the ground, all points of which are at the same elevation above or below a specified reference surface.

Control mapping: Points of established position or elevation, or both, that are used to fix references in positioning and correlating map features. Supplemental control points are those needed to relate aerial photographs used for mapping with the system of ground control. These points must be positively photo identified; that is, the points must be positively correlated with their images on the photographs.

Cooperating agency: Any Federal, State, or local government agency that assists with the inventory plan or implementation.

Culture: Features constructed by humans that are under, on, or above the ground that are delineated on a map. Culture includes roads, trails, buildings, canals, sewer systems, and boundary lines. In a broad sense, culture also applies to all names, legends, and other identification on a map.

Data Base Management System (DBMS): A software program used to store geospatial data in an organized way so that it can be easily retrieved, modified, and manipulated.

Data: Information—especially information organized for analysis or used as the basis for a decision.

Datum: In ordinary survey usage, a defined reference for survey measurements. The plural form is datums.

DBMS: Data Base Management System.

Designated roads and trails: Specific roads and trails identified by the BLM (or other agencies) where some type of use is appropriate and allowed either seasonally or year-round.

Digital data: Data displayed, recorded, or stored in a digital format.

Digital orthophoto quadrangle (DOQ): A USGS digital product derived from high-altitude aerial photography. These digital images are rectified and registered to locations on the earth and correspond to a 7.5-minute quadrangle. DOQs are often used as base maps to register the photo-interpreted data in a route inventory program.

A computer-generated, georeferenced image of an aerial photograph where the image displacement caused by terrain relief and camera tilt has been removed. A DOQ corresponds to a USGS 7.5-minute map.

Digital orthophoto quarter quadrangle (DOQQ): One quarter of a DOQ, which corresponds to a USGS 3.75-minute map.

Digital raster graphic (DRG): A scanned image of a paper USGS topographic map. The geographic information is georeferenced in the UTM projection with the accuracy and datum of the original map. The minimum scanning resolution is 250 dots per inch. DRGs are useful layers in a geographic information system.

Digital Versatile Disc (DVD): An optical digital disc used for storing movies and data. Introduced in the U.S. in 1997, and developed by both the movie and computer industries, the DVD uses the same diameter platter as a CD but holds 4.7GB rather than 700MB. Where CDs record on only one side, DVDs record on both sides, as well as in dual layers.

Digitization: The process of converting spatial information, originally compiled on orthophotographic materials or base maps, into digital form for incorporation into a geographic information system database. Also refers to the referencing of ground control points or lines to a remotely sensed image.

DOQ: Digital orthophoto quadrangle.

DOQQ: Digital orthophoto quarter quadrangle.

DRG: Digital raster graphic.

Enterprise GIS: A system that allows BLM employees and stakeholders to access geospatial data, information, and knowledge whenever and wherever it is needed.

Evaluation (plan evaluation): The process of reviewing the land use plan and the periodic plan monitoring reports to determine whether the land use plan decisions and NEPA analysis are still valid and whether the plan is being implemented.

Facility Asset Management System (FAMS): Database of all BLM assets including those routes that make up the BLM transportation system. Although not every route is considered part of the transportation system, all route inventories will identify the required data elements included in FAMS

FAMS: Facility Asset Management System.

Federal Land Policy and Management Act of 1976 (FLPMA): Public Law 94-579, October 21, 1976, often referred to as the BLM's "Organic Act," provides the majority of the BLM's legislated authority, direction policy, and basic management guidance.

FGDC: Federal Geographic Data Committee.

Fine-scale data: Fine-scale data sets support local information needs and represent the highest thematic detail and spatial accuracy. Data at this scale are intended for project-specific planning, monitoring, and evaluation, and would typically be represented at the 1:24,000 map scale.

FLPMA: Federal Land Policy and Management Act of 1976.

Geographic Information System (GIS): A system of computer hardware, software, data, people, and applications that capture, store, edit, analyze, and graphically display a potentially wide array of geospatial information.

GIS: Geographic Information System.

GLIS: Global Land Information System.

Global Positioning System (GPS): A navigational and positioning system by which the location on or above the Earth can be determined by a special receiver at that point interpreting signals received simultaneously from several constellations of special satellites.

Goal: A broad statement of a desired outcome; usually not quantifiable and may not have established time frames for achievement.

GPS: Global Positioning System.

Ground truthing: Verification and validation of geospatial data through field work.

Guidelines: Actions or management practices that may be used to achieve desired outcomes, sometimes expressed as best management practices.

HBCU: Historically Black Colleges and Universities.

Implementation plan: As related to land use planning, an area or site-specific plan written to implement decisions made in the Land Use Plan (LUP). There are two types of implementation plans—activity plans and project plans.

Inventory: The systematic acquisition and analysis of resource information needed for planning and management purposes.

IRS: Indian Remote Sensing satellite.

ITDS: Interagency Trail Data Standards.

Land cover: The biophysical materials covering the surface of the land, including soil, water, vegetation, and human cultural activities.

Land Use Plan (LUP): A set of decisions that establish management direction for land within an administrative area, as prescribed under the planning provisions of FLPMA, an assimilation of land-use-plan-level decisions developed through the planning process outlined in 43 CFR 1600, regardless of the scale at which the decisions were developed. The LUP addresses resource management and includes a defined travel management system of areas, roads, primitive roads, and trails.

Landmark: Monument of material mark or fixed object used to designate a land boundary on the ground. Any prominent object on land that may be used to determine a location or a direction in navigation or surveying.

Landscape: A heterogeneous land area with interacting ecosystems that are repeated in similar form throughout.

Landscape Block: A specific landscape unit used in analysis (for example, a drainage).

Landscape Features: The land and water form, vegetation, and structures that compose the characteristic landscape.

Limited: Route designation restricting use by season or mode of transportation.

Line map: Map composed of lines as distinguished from a photomap created from a photographic image.

Linear disturbances: The term used to identify human-made linear features that are not part of the Bureau's transportation system. Linear disturbances may include engineered (planned) as well as unplanned single- and two-track linear features that are not designated as part of the Bureau's transportation system.

Linear features: Linear features represent the broadest category of physical disturbance (planned and unplanned) on BLM land. Transportation-related linear features include engineered roads and trails, as well as user-defined, nonengineered roads and trails created as a result of the public use of BLM land. Linear features may include roads and trails identified for closure or removal, as well as those that make up the Bureau's defined transportation network.

LSIS: Land Survey Information System.

Management decision: A decision made by the BLM to manage public lands. Management decisions include both land use plan decisions and implementation decisions.

Map: A conventional representation, usually on a plane surface and at an established scale, of the physical features (natural, artificial, or both) of a part or the whole of the Earth's surface. Features are identified by means of signs and symbols, and geographical orientation is indicated.

Map digitization: The process of converting map data from graphic to digital form.

Midscale-data: Usually 1:100,000 scale, the "midscale" dataset supports information needs at scales between the local and State or regional levels. Typical usage includes land use planning, rangeland monitoring, and assessment.

Monitoring (plan monitoring): The regular collection of data over time to evaluate the effectiveness of land use planning decisions.

MrSID: Multi-Resolution Seamless Image Database.

NAD27: North American Datum of 1927.

NAD83: North American Datum of 1983.

NAIP: National Agriculture Imagery Program.

NAPP: National Aerial Photography Program.

National Map Accuracy Standards (NMAS): Specifications promulgated by the U.S. Office of Management and Budget to govern the accuracy of topographic and other maps produced by Federal agencies.

NEPA: National Environmental Policy Act.

NHT: National Historic Trails.

NMAS: National Map Accuracy Standards.

NSDI: National Spatial Data Infrastructure.

NSSDA: National Standards for Spatial Data Accuracy.

NST: National Scenic Trail.

NTC: National Training Center.

Open: Generally denotes that an area is available for a particular use or uses. Refer to specific program definitions found in law, regulations, or policy guidance for application to individual programs. For example, 43 CFR 8340.0-5 defines the specific meaning of "open" as it relates to off-highway vehicle use.

Orthoimage: A digital image that has been ortho-rectified, eliminating displacement caused by perspective, sensor tilt, or terrain relief. (Also known as an ortho.)

Ortho-rectification: The process of eliminating displacement caused by perspective, camera or sensor tilt, and terrain relief. (See also orthophotograph.)

Overlay: Printing or drawing on a transparent or translucent medium intended to be placed in register on a map or other graphic and that shows details not appearing or requiring special emphasis on the base map.

Photogrammetry: the art and science of obtaining reliable measurements or information from photographs or other sensing system.

Photomap (photographic map): A map made by adding marginal information, descriptive data, and a reference system to a photograph or assembly of photographs.

Planimetric map: A map that presents only the horizontal positions for features represented, often referred to as a line map.

Plat: A diagram drawn to scale showing all essential data pertaining to the boundaries and subdivisions of a tract of land, as determined by survey or protraction.

PLSS: Public Land Survey System.

Primitive road: A type of transportation-related linear feature that is used by four-wheel drive or high-clearance vehicles. Primitive roads do not customarily meet any Bureau road design standards.

Public land: Land or interest in land owned by the United States and administered by the Secretary of the Interior through the Bureau of Land Management without regard to how the United States acquired ownership, except lands located on the Outer Continental Shelf and land held for the benefit of Indians, Aleuts, and Eskimos.

RDBMS: Relational Data Base Management System.

Relational Data Base Management System (RDBMS): A set of programs used to store data in related tables. The tables are related to each other through items known as primary and secondary keys. Data updating, retrieval, and manipulation is much more efficient in a RDBMS.

Remote sensing: Collecting information about an object without being in actual contact with the object.

Resolution: A measure of the finest detail distinguished in a geospatial image. High resolution (1-meter detail) versus low resolution (15-meter detail).

Resource Management Plan (RMP): A BLM planning document, prepared in accordance with Section 202 of the Federal Land Policy and Management Act (FLPMA), that presents systematic guidelines for making resource management decisions for a planning area. An RMP is based on an analysis.

Resource use level: The level of use allowed within an area, based on the desired outcomes and land use allocations from the Land Use Plan (LUP). Targets or goals for resource use levels are established on an areawide or broad watershed level in the LUP. Site-specific resource use levels are usually determined at the implementation level, on the basis of site-specific resource conditions and needs as determined through resource monitoring and assessments.

RMA: Recreation Management Area.

RMIS: Recreation Management Information System.

RMP: Resource Management Plan.

Road: A linear route declared a road by the owner, managed for use by low-clearance vehicles having four or more wheels, and maintained for regular and continuous use.

Root Mean Square (RMS): A standard used to measure map accuracy representing the square root of the average value of the sum of the squares of the differences between the values in a set and the corresponding values that have been accepted as correct.

Satellite Probatoire d'Observation de la Terre (SPOT): A civilian Earth observation program, sponsored by the French government with support from Belgium and Sweden.

A single SPOT satellite provides complete coverage of the Earth every 26 days and produces images with a resolution of as much as 10 meters. Image products from SPOT are handled commercially by SPOT-Image Corp.

Scale: The relation between a distance on a map, chart, or photograph and the corresponding distance on the Earth.

Soil Erosion: The phenomenon of detachment and transport of soil from the land surface by the action of wind, water, or ice.

SPOT: Satellite Probatoire d'Observation de la Terre.

SQL: Sequential Query Language.

Strategic plan (DOI strategic plan): A plan that establishes the overall direction for all DOI Bureaus, including the BLM. This plan is guided by the requirements of the Government Performance and Results Act of 1993, covers a 5-year period, and is updated every 3 years. It is consistent with FLPMA and other laws affecting the public lands.

Survey: To determine area, elevation, boundaries, and features of land or structures on the earth's surface by means of measuring angles and distances.

Topographic map: A map that presents the horizontal and vertical positions of the features represented; it is distinguished from a planimetric map by the addition of relief in measurable form.

Trail: A linear route managed for human-powered, stock, or off-highway vehicle forms of transportation or for historical or heritage values. Trails are not generally managed for use by four-wheel drive or high-clearance vehicles.

Transportation network: The total of all transportation-related linear features (roads, primitive roads, and trails) found on public lands.

Transportation system: The roads, primitive roads, and trails designated as facility assets and maintained by the BLM.

Travel management areas: Polygons or delineated areas where a rational approach has been taken to classify areas open, closed, or limited, and that have identified or designated networks of roads, primitive roads, and trails that provide for public access and travel across

the planning area. All designated travel routes within travel management areas should have a clearly identified need and purpose, as well as clearly defined activity types, modes of travel, and seasons or time frames for allowable access or other limitations.

TTMP: Travel and Transportation Management Plan.

USDA: U.S. Department of Agriculture.

USFS: U.S. Forest Service.

USFWS: U.S. Fish and Wildlife Service.

USGS: U.S. Geological Survey.

UTM: Universal Transverse Mercator.

WA: Wilderness Area.

WSA: Wilderness Study Area.

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